Monitoring Collective Intelligence in Lithuania's Online Communities

Aelita Skarzauskiene
Vilnius Gediminas Technical
University, Vilnius, Lithuania
aelita.skarzauskiene@vilniustech.lt

Abstract

This paper presents the findings of a systematic survey that evaluated the potential of online communities (or Civic Tech) in Lithuania to co-create collective intelligence. Traditional approaches to public engagement remain relevant, notwithstanding, our enquiry is more interested in the growing potential of digital-enabled citizens to increase efficient collective performance. Civic intelligence is a form of collective intelligence exercised by a group's capacity to perceive societal problems and its ability to address them effectively. The subject of the research is "bottom up" digital-enabled online platforms initiated by Lithuanian public organizations, civic movements and/or business entities. This scientific project advances our understanding about the basic preconditions in online communities through which collective intelligence is being systematically co-created. By monitoring the performance of Civic Tech platforms, the scientific question was examined, what are the socio-technological conditions that led the communities to become more intelligent. The results of web-based monitoring were obtained by applying Collective intelligence Monitoring technique and Pearson correlation analysis. This provided information about the potential and limits of online communities, and what changes may be needed to overcome such limitations.

1. Introduction

The field of ICT enabled Civic Technologies (or Civic Tech) is an umbrella term to define ICT-enabled citizen initiatives, and is growing annually by 23% according to the Knight Foundation [1]. Around the world, civic organizations, individual citizens and even businesses experiment with the ICT tools and available open resources to connect and collaborate with each other and with government to find innovative solutions to address societal problems [2]. To support this, the international scientific community publishes research results about the creative power of networked systems and their potential to grow under certain conditions, i.e. "collective intelligence" [3-4]. More recently, Engel et al. [5] indicate that a collective intelligence factor characterizes group performance for online groups approximately as well as for face-to-face groups.

Despite the enthusiasm and optimism regarding the efficiency of the activities of online communities and their influence on public good, this is supported only with fragmented research results [6]. Most scientific activities are biased in favor of governmental initiatives and the integration of e-participation, e-democracy and open data tools. Because of the diversity in technological tools and information channels, the users of urban platforms face *in praxis* problems with coordination, collective decision-making and opinion structuring, security and privacy, information credibility, and content quality, etc. As online communities continue to proliferate, "further research is needed to better understand how these communities use technology-mediated communication platforms for both hedonic and utilitarian purposes, including enhanced decision-making" [7]. Moreover, some initiatives by citizens narrowly focus on the formation of society's voice, yet fail to emphasize feedback from government and importance of co-creative synergy between all stakeholders [8].

Our paper is based on the presumption that the networked society is likely to be a key player in future society, because it has a decentralized structure and operates on a user-to-user mode, developing productive computer supported collaboration. The concept of co-creation fundamentally differs from the traditional public engagement approach, in that it focuses on collective intelligence, awareness and responsibility of all stakeholders by creating the public good. Lithuania's networked society urgently needs to upgrade co-creation processes between the civic and the public to raise it to the next qualitative level. One breakthrough in the finance sector was created through "blockchain" technologies, and this could equally be applied in Civic Tech management to implement democratic-by-design models of governance**,** establish decentralized and transparent decision-making and motivation systems that enable secure, efficient and anonymous

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engagement. Instead of relying on traditional top-down decision-making procedures, the "blockchain" allows for such procedures to be crowd sourced entirely, delegating the responsibility to monitor and evaluate its own achievements to the community's collective intelligence [9]. Hence, we need to develop scientific evidence based social models in order to formulate objectives for IT developers who can then create and apply the better targeted and value creating technological solutions.

Our project extends existing knowledge and understanding by *evaluating the* basic co-creation preconditions in Civic Tech through *which collective intelligence emerges in a systemic manner.* The particular research subject is "bottom up" digital enabled networked platforms, initiated by public organisations, civic movements or business entities. The sample size for web-based monitoring consist of 70 online communities in Lithuania identified and classified during the pilot research.

2. Co-creating Collective Intelligence in Civic Tech

Both concepts (co-creation (CC) and collective intelligence (CI)) were influenced by social media technologies and were developed in parallel. The efforts to more effectively leverage CI are improving the effectiveness with which "public value" is co-created [16]. The ICT enabled systems leverage "the emerging network effect" by combining open online social media, distributed knowledge creation and data from real environments ("Internet of Things") in order to create possible solutions requesting collective efforts" [10]. According to the collective intelligence paradigm, under certain conditions, the human group demonstrates the higher capabilities of information-processing and problem solving than an individual [4]. The "intelligence" in the system can be described as "collective", not only in the sense that it arises from the interactions between participants, but also that it does so according to specific principles for extracting "wisdom from crowds": diversity, decentralization, independence and an appropriate mechanism for information aggregation [3]. All of these principals affect not only the emergence of CI, but also can influence positively the co-creation processes inside and outside the community enhancing the collaboration between stakeholders.

According to McNutt et al. [17], development in the field of Civic Tech is influenced by innovations in the three fields: growing connectivity through ICT; open data movement; and diversity in digital collaboration forms. Open data increases the visibility and speedy identification of societal problems, while new collaboration and knowledge aggregation methods enable self-organization and collective decision-making. Mass participation in online interactions means greater diversity, richer data, and the continuous inflow of new ideas and knowledge. Emulating the fundamental design of the Internet, the networks adopted a decentralized structure and distributed leadership. This influences self-organization and self-governance capabilities of the community which challenges the traditional hierarchical mechanism. Since structural units (nodes) are unable to interact with the center of the network (because it does not exist), they must interact with the network as a whole in a self-regulatory regime and in so doing develop one of the most productive forms of collaboration [18].

Several researchers [11-12] propose that the roles, perceptions and capacities of actors involved play a central role as drivers or barriers in the co-creative processes. A *top-down co-creation approach* refers to government-initiated platforms that deliver public services. Engaged as they are in government established platforms, citizens contribute to data and content distribution, or/and are involved in the design, evaluation or improvement of public services, based on user-centric approaches (e.g. Design thinking, Service Co-Production). A *bottom-up co-creation approach* defines the platforms emerging from the outside of the governmental sector and without governmental control. According to Badger [13] and Suri [14], bottom-up civic technologies are not necessarily designed with the aim of being corporate and disruptive to government (a case in point being the so-called Arab Spring of 2011). Instead, they are designed "by, and for, average citizens, using existing open data in innovative ways that can complement the existing channels of information and communication previously controlled by the institutions alone" [13-14].

This research paper examines "bottom up" co-creation of collective intelligence in Civic Tech, which defines an internal and external motivation of platforms` users to act for the public good. "New knowledge, ideas, problem solving methods and solutions, shaped up or structured opinions, innovations, prototypes, etc. are considered to be the collective intelligence a platform co-creates and "public value" for society" [15]. Here, it is important to note that critical reflection on the co-creation practices is relevant to our understanding of how the digital enabled managerial and organizational solutions influence the quality of co-creation results. Further, this applies with regard to what works when co-creations methods are implemented, as well as what does not work, and why. A deeper understanding of the dynamics of co-creation is needed to support communities to deliver intended intellectual outcomes.

3. Monitoring Collective Intelligence: Pilot study in Lithuania

3.1. European and national context

A number of EU strategic policy documents (e.g. Europe 2020 Strategy; EU Digital Agenda) have stressed the importance of the ICT-enabled society and open access to information as one of the key factors in fostering democracy. National governments in the EU have invested heavily in e-government and e-democracy projects in the anticipation of greater citizen participation and the resulting co-creation. The reality of open government practice is, however, different. According to recent research results [7-8], it has taken a turn towards the market-based principles of performance measurement and competition, thereby reinforcing a framework which focuses on the customers who demand to be served rather than on the citizens working with their representatives to co-create public value. A Pew Research Centre survey [21] shows that significant numbers of Europeans believe that EU institutions are deaf to their concerns and opinions. Indeed, measured by the quarterly Eurobarometer, confidence in national parliaments and governments is low and slowly declining [22].

Lithuania's democracy is facing similar challenges. Lithuania is a small country in the Baltic region of northern-eastern Europe, with 2.8 million inhabitants in an area of 65,300 square kilometres. Lithuania gained its Independence from the Soviet Union in 1990 and this fact created crucial changes in all areas of Lithuania and its citizens. In recent years, the Web's reach and capability has helped to facilitate the explosive growth of online communities, yet their full potential is unrealised due to the lack of citizen engagement. Lithuania has all of the preconditions to become a networked society: a relatively high level of the infrastructure of information technologies, a high level of user accessibility. Despite enjoying seemingly perfect pre-conditions, collective intelligence has developed slowly, simply because people do not collaborate. They may express their opinions, but do not structure them, and reject the obligation to implement decisions, etc. According to Lithuanian Smart Specialisation Strategy documents the potential of non-governmental organizations promoting social innovation and business is largely untapped, with Lithuania ranked 13th in DESK 2017 [23]. The country's` performance is above the EU average in all dimensions, except for Human Capital, where progress has been limited by the country's inability to use digital technologies to address social challenges. The majority of the public government initiatives are centralised and do not reach citizens` empowerment according Guogis and Urvikis [24]. For example, there are few proposals in the government-initiated portal for public consultations via e-pilietis (e-citizen) compared to the active citizen-initiated discussions in social media and portals.

Scientific viewpoint and analysis of the influence of social technologies on formation of collective intelligence raises many questions. Society faces a practical problem pertaining to the existence of a wide variety of social technologies and functioning of many diverse societal platforms. It is important to understand that Open Data, Open Science, Open Source Freeware, and Open Community needs to be supported by a resilient social system, otherwise their value-making potential remains limited. If the value dimensions of users acting in a collective network are misaligned, and if the technological decisions are implemented in an immature environment, these solutions can accelerate the negative aspects of digital collaboration. These risks manifest themselves as "closing up within one's communities, constraints of individual freedom, the privileged access to community resources and limitations on the engagement of outside persons" [20]. On the other hand, the technological design and structure of the network give impetus to purposeful collaboration towards the common good. According Nam (2012) [30], in proposing framework that can be used for investigating citizen-sourcing platform's set of three basic categories have to be used: 1) design evaluation, 2) process evaluation and 3) outcome evaluation. The applied in this paper Collective Intelligence Potential Index (CIPI) monitoring technique [15] focuses on facilitating framework to evaluate the design, to analyze the processes and to compare the online community projects and their potential to generate intellectual outcomes for common good.

3.2. Methodology: application of Collective intelligence Potential Index

The pilot study was conducted in Lithuania from 2019 to 2020, and its main task was to evaluate the co-creation practices by examining the dynamics that reflect the impact of technology, context, and changes of various internal and external parameters. The research subject was the "*bottom up*" co-creation process in Lithuania's Civic Tech, initiated by public organizations, civic movements or business entities. The monitoring of the online communities was implemented by applying the Collective Intelligence Monitoring Technique [15]. The proposed Collective Intelligence Potential Index (CIPI) monitoring technique focuses on facilitating framework to evaluate, analyze and compare

the online community projects and their potential to generate intellectual outcomes for common good. The CIPI calculation methodology is an outcome of the 2 years EU Global Grant research project "Social Technologies for Development of Collective Intelligence in Networked Society". The methodology was validated by implementing quantitative and qualitative research, by developing a system-dynamic model to test causal relationships and by the experimental application of the method in praxis [25, 28, 29]. The data necessary for the identification of the indicators parameters as well as initial values of stocks were collected by implementing the longitudinal web-based monitoring of CI in online communities. The research was conducted in two stages. The first stage was exploratory. The researchers used certain criteria to compile a list of Civic Tech targeted for research project. The research sample of 70 communities was established according to the following criteria: Lithuanian origin of urban (related to town or city) communities; communities with specific goals and social innovation orientation; and communities able to involve a critical mass of users and operating more than 1 year. Most of the analysed platforms were initiated by non-profit organizations. The initial list of Civic Tech included 120 platforms. However, some projects were removed from the list for different reasons, such as adequacy to projects objectives, viability, level of diversity, comparability, lack of numeric data, etc. The second stage integrated monitoring of activities in selected communities and collecting data form Google analytics scripts. Apart from monitoring the communities, the stage incorporated negotiations with platform developers and administrators to get access to specific *web analytics* data. Monitoring instrument encompassed different types of criteria based on numeric, binary and qualitative data. The chosen subjects were observed in accordance with the designed survey scheme (representative parameters) and the collected data underwent qualitative analysis and summarized to make corresponding conclusions. Each platform was evaluated independently by two researchers seeking inter-judge reliability.

For the data processing, a virtual research environment with the required software for the calculation of CIPI was applied available online (in Lithuanian language only). The structure of CIPI, questionnaires and experimental evaluation results are available on the projects` website www.collective-intelligence.lt in the Publications section (in two languages: English and Lithuanian). The values of indicators underwent a qualitative evaluation and numeric values were ascribed that correspond to their quantitative weight: 0; 0.5 or 1. To improve the users` perception, the obtained values of the composite indices were transformed into a more attractive scale by multiplying the obtained values by 100 (0 is the lowest and 100 the highest performance level). The values of answers to questions were transformed into a numeric scale in accordance with the following procedure: Yes-, No-0, High -1, Medium-0,5, Low-0. Based on theoretical insights and empirical research results by developing CIPI instrument [31] the indicators inside of indices are not equally significant, for example DS, DF PS indicators of CI Capacity Index have more weight (60%) than indicators of CM, DD, DI (40%) (see Table 1).

The Collective Intelligence Potential Index (CIPI) evaluates the basic characteristics, functionality, and technological design of online platforms using a set of integral socio-technological indicators (Collective Intelligence Capacity (CAI), Collective Intelligence Emergence (EI), Social Networked Responsibility (SRI) and Social Technologies Index (STI). The calculation of the four (4) sub-indices integrates quantitative data with the results of content analysis by monitoring the communities' activities in virtual space. The CI Capacity Index is a relational conception that defines the capacity of the community for creativity, aggregating and creating knowledge, decision-making and problem solving. The CI Emergence Index evaluates the ability of online community for self-organization, potential for emergence of intellectual outcomes and adaptivity. The Social Responsiveness Index assesses the maturity of social impact on society, maturity of social motivation and maturity of social orientation. The Social Technologies Index explores the system`s structure, design and technological solutions enabling human-machine interaction. While CAI, SRI and STI indices are related to preconditions for co-creating collective intelligence, CI Emergence Index evaluates the outcomes of the process and CI results.

3.2. Monitoring results

The CIPI monitoring results are presented in Table 1. As mentioned previously, the CIPI is designed around four (4) indices: CI Capacity Index (CAI), CI Emergence Index (EI), Social Responsiveness (SRI), and Social Technology Index (STI). At the current stage of the research, the assumption is that four (4) indices are equally significant. The final mean of CIPI of the 70 Civic Tech communities is **52.00** (48.68+51,66+46.99+60.69/4) (Table 1).

Table 1. CIPI monitoring results

Dimension	Values		Indicators	Values
CI Capacity Index	**48,68**		$CAI = 0{,}6\frac{DS+DF+PS}{3} + 0{,}4\frac{CM+DD+DI}{3}$,	
Capacity for creativity		DS	Degree of diversity in source of ideas	48,64
		DF	Degree of diversity in engagement forms	43,33
Capacity for aggregating and creating knowledge		DI	Degree of interdependence	51,58
		CM	Degree of adequate supply of "Critical mass" ("swarm effect")	49,09
Capacity for decision making and problem solving		DD	Degree of decentralization and independence	43,64
		PS	Degree of efficiency of problem solving	54,73
CI Emergence Index	**41,99**		$EI = 0{,}6\frac{DQ+FG}{2} + 0{,}4\frac{DC+AT+DM+AL}{4}$	
Potential for self-organization		AT	Degree of adequacy in form of self-organization to the community task	56,97
		DC	Degree of development of transparent structure and culture	67,95
		DM	Degree of development of distributed memory system	46,06
Intensity of emergence of intellectual outcomes ("public value")		DQ	Degree of emergence of new ideas, structured opinions, competencies, activities, etc.	46,36
		FG	Intensity of feedback from government and other stakeholders	20,00
Potential for adaptivity		AL	Degree of adequacy to socio-cultural context (local, national, global)	50,00
Social Responsiveness Index	**46,99**		$SRI = 0{,}6\frac{DT+SR+MC}{3} + 0{,}4\frac{MM+SS+RS+IE}{4}$	
Maturity of social impact on society		DT	Degree of sustainability	38,00
		SR	Speed of reaction to social issues	68,00
		MC	Maturity of generated content	46,00
Maturity of social motivation		MM	Maturity of social motivation of community	47,00
		SS	Level of social sensitivity of community members	52,00
Maturity of social orientation		RS	Degree of diversity in cooperating partners and financing	32,00
				35,00
		IE	Strength of internal and external connections with stakeholders	
Social Technologies Index	**60,69**		$STI = 0{,}4MD + 0{,}6\frac{EIT+PS+DM+DA+SC}{5}$	
		MD	Media/ design quality	60,00
		EIT	External/internal networking technologies.	69,00
		PS	Privacy/ security assurance technologies.	43,03
		DM	Decision making technologies	60,00
		DA	Data aggregation and data access technologies	69,70
		SC	Sharing/creating knowledge technologies	63,82
Collective Intelligence Potential Index	**52,00**		$CIPI = \frac{CICI+CIEI+SRI+STI}{4}$	
			48.68+51,66+46.99+60.69/4 = 52,00	

The CI Capacity Index of the evaluated communities has the highest mean to compare with the other sub-indices. When measuring the *Degree of diversity in source of ideas* (value of 48,64) and *Engagement forms* (43,33), demographic, gender and geographic diversity was evaluated as high in the majority of monitored projects. However, national diversity was defined as being relatively low. Almost all civic projects lack the advanced competition elements, game-based approach, and the adoption for the different age groups. *Degree of decentralization and efficiency of problem solving* was identified as rather low. In the majority of the platforms only the registered users are able to propose an idea on already posted issues, and there are only few projects allowing an anonymous participation. The diversity in the ways to express opinions (such as voting, ranking, structuring, mass deliberation, etc.) is low in the majority of the observed communities as they lack the technological solutions. The Pearson correlation results (Table 2) support the presumption that the maturity in problem solving, diversity and quality of created knowledge/products are better maintained by providing the advanced technological tools for users not only to express their opinion, but also to vote, evaluate and make collective decisions. On the other hand, in many cases the possibilities for the users to initiate a new topic, aggregate or create knowledge are limited due to the clear leadership of initiators or managers of platforms.

The value of the CI Emergence Index is influenced by the *Level of self-organisation* (56,97) and *Development of transparent structure* (67,95). The observed platforms demonstrate a high performance in these dimensions. Moreover, the lower values were identified in the *Intensity of emergence of new ideas, activities*, *Development of distributed memory system* and especially in the *Feedback from government and other stakeholders.* The level of diversity in the addressed problems, insights and proposed ideas varies from low to medium. With the rare exceptions, the exchanges of information in the civic projects are dominant.

The Social Responsiveness Index has a higher value to compare with the CI Emergence Index. Lithuania's online communities demonstrate high levels of *Speed of reaction to social issues* (68) and also *Level of social sensitivity* (52). However, the platforms lack sustainability, visibility and support from cooperating partners and stakeholders. Few platforms publish data on the implemented actions and initiatives. The majority of the results are named as publications or implemented ideas that improve a performance of the platform itself.

It is interesting to note that the virtual projects with broad objectives to tackle societal problems demonstrate the wider variety of offered ideas, more mature discussions, and higher quality solutions than those with a narrower focus on specific issues.

Social technologies perform as a supporting mechanism for effective and efficient activities of online platforms. However, technological solutions for collective brainstorming, collective assessment or decision-making are underdeveloped in the majority of projects. Technological solutions, such as support of interaction, interactivity, protection of data and the security of processes, grouping and analysis of discussions, multilayer environment of discussions, are vital for the formation of collective intelligence. The level of knowledge aggregation and sharing among the monitored communities was identified above the average. The most developed technologies are those which foster the formation of interest groups and sharing information. Greater attention should be paid to the privacy and personal data protection technologies, because only half of the platforms have these IT tools installed in order to protect their users.

Limitations. In the absence of the index calculation results that were equally tested in another socio-cultural context, the comparative value of the outcomes of this research cannot be established. However, the numeric values of the final CIPI and the values of sub-indices can be compared with the average of the already evaluated platforms aiming to get the insights about the potential of the networked systems for generating the intended intellectual outcomes. Another limitation is related to qualitative assessment. The increase of collected empirical data would condition the increase in research data reliability and validity of the applied instrument.

In direction to further work the relationships between different indices could be evaluated statistically to understand the causality between different variables.

4. Conclusions and discussion

From sharing knowledge to producing the technology, and from cooperation to competition, further research is needed into the way ICT supported co-creation works. Notably, this is an area of continuous exploration for practitioners and research scholars. With the increasing complexity of networked systems and greater connectivity between humans and machines, the characteristics of those systems are crucial in terms of determining the performance and successful development of collaborations. The ability to influence performance is dependent on the accurate assessment of the systems and their dynamics. The challenge confronting the proposed Collective Intelligence Monitoring Technique was to correlate different factors and to find realisable preconditions for the collective intelligence to emerge in the systemic way. Not all aspects of the platform's performance can be measured

by such clear criteria, however collecting empirical numeric data is vitally important. Storing such data over a period could be useful in predicting the performance of the online community as a whole or help diagnose and prevent the reduction of community members' motivation or diminished activities.

The monitoring results provided information about the limits of the Civic Tech platforms and changes that need to be implemented in order to overcome the limitations. This can be described figuratively, such that by applying the assessment methodology, Lithuania's online communities have passed the cognitive, emotional and social intelligence tests and revised their digital competencies. The evaluation conclusions provided a "helicopter view" on digital co-creation practices in Lithuania, distilled the best practices, identified game changing communities, and expanded the opportunities for designing targeted engagement strategies. It can be concluded, that Lithuanian Civic Tech possess high level of technological preconditions (Social Technologies Index). However, the lower values in CI outcomes (CI Emergence Index) can be explained through low and medium scores in CI Capacity Index and Social Responsiveness Index. The explored communities lack capacity to creativity, diversity, decision making and problem solving, they also usually have lower degree in sustainability, maturity, internal and external connections. The monitored online communities are considerably different, but they are united by social orientation towards the problems of society and the wish to create a better environment around them. However, the majority of them does not extensively use the potential of Collective Intelligence and is frequently limited by rather narrow group interests or even become an instrument of individual self-realization or marketing.

Evaluation of common standards, procedures, values, and so on should be given bigger significance in developing online communities, whereas mature ones should be assessed additionally according to leadership, balance, technological and procedural openness factors. It can be concluded that CI formation in Lithuania's` Civic Tech is at its initial stage, thus to discuss particular results is too early. Yet, development of civic engagement can also be seen as collective consciousness and a form of collective Intelligence respectively. Communities in pursuance of their vision and mission implementation solve problems and perform activities, adaptively reacting to the essential problems. Most of them actively learn and exchange information by carrying out activities, thus creating preconditions for development of collective intelligence in Lithuania. In addition, the Civic Tech progress in Lithuania and perfect technological preconditions in the country can be used as a test bed to explore the potential of computer supported collaborative work in the future.

Exploring the potential of Web enabled Collective intelligence could have huge practical implications by influencing more reasonable and sophisticated application of social technologies in practice. The ability to recognize CI in virtual communities can help communities multiply their abilities to organize themselves and become more productive and efficient. Understanding co-creation processes in online platforms could contribute to solving the different social problems of the networked society through the virtual means. While online platforms will probably be the first to experiment with these new IT tools, they could be easily taken offline to create and build new organizations that operate in the physical world by multiplying the successful cooperation models on the national or international scale. The applied CI Monitoring Technique is expected to facilitate policy makers, business designers and community managers or moderators to recognize, whether a community has the potential of becoming a CI system, to maximize the benefit that the community and individual users will receive from the system and decide on the adequate technological design and solutions. By evaluating the existing collaboration platforms, the opportunity for IT developers will be created to integrate or to develop new tools that can be exploited through a community or stakeholders to create and enrich human-machine networks.

In conclusion, the current knowledge level the technological readiness is an important feature of the co-creation process. The IT tools and solutions have to create the additional social value to the platforms` activities and contribute to the identity of the community. IT solutions have to be chosen in such a way that the operation of the main elements of the model of collective intelligence would be insured, e.g. technological solutions are mainly responsible for the formation of creativity, diversity and trust (lower barriers of communication for reaching a particular member of the community, conditions for comments and expression of one's positions and limit in time as well as technical possibilities). If online community impedes communication, limits its speed, frequency, the contents of discussions, the number of messages, it hinders the spontaneity of the interaction of the members of the community; this in itself reduces trust in the system and alienates members from one another, i.e. average distances between members become longer. The design of networked platform has to be created with and for community.

Currently, scientific questions regarding Civic Tech management cannot be satisfactorily answered because researchers are only now beginning to understand the

complexity of similar systems, and their possibilities and threats. Our view is that co-creation is more than just sharing, reacting, voting and/or making decisions. The phenomenon is more about being proactive in finding problems and contributing to solve a variety of social problems. Digital co-created collective intelligence has the potential to become global in terms of its geographic reach and content, although it still has to be parametrized and credibly measured. Perhaps the focus of the researchers should be on developing holistic interdisciplinary conceptions in order to understand the complexity of self-organizing and "emergent" networked systems, and forecasting their development scenarios.

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